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FREMONT MILL BRIDGE
(Central Park Bridge)
Iowa Bridges Recording Project
Central Park
Anamosa Vicinity (moved from Monticello)
Jones County
Iowa

HAER No. IA-58

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WRITTEN HISTORICAL & DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Department of the Interior
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HISTORIC AMERICAN ENGINEERING RECORD

FREMONT MILL BRIDGE
(Central Park Bridge)

HAER No. IA-58

Location:	Central Park in Center Junction, seven miles east of Anamosa, Jones County, Iowa. (moved from monticello) UTM: 15.654390.4663460 USGS: Morley, Iowa quadrangle (7.5 minute series, 1980)
Date of Construction:	1873
Designer:	Massillon Iron Bridge Company, Massillon, OH
Contractor:	Massillon Iron Bridge Company, Massillon, OH (superstructure) James Milne, Scotch Grove, IA (substructure)
Owner:	Jones County Conservation Board
Present Use:	Pedestrian bridge. Formerly a roadway bridge, spanning the Maquoketa River in Monticello, Iowa.
Significance:	The Fremont Mill Bridge was built during the heyday of the use of bowstring arch-trusses. In the 1860s and 1870s bowstring arch-trusses were used extensively because of their great structural efficiency and relatively low construction costs. The Fremont Mill bridge is an excellent example of the work of the Joseph Davenport's Massillon Iron Bridge Company, a major bridge fabricator who erected many of these type of bridges throughout the nation. This bridge is also of great interest because it employs the unusual built-up lattice girders of Davenport's patent.
Historian:	Geoffrey H. Goldberg, engineer, August 1995
Project Information:	This document was prepared as part of the Iowa Historic Bridges Recording Project during the summer of 1995 by the Historic American Engineering Record (HAER). The project was sponsored by the

Iowa Department of Transportation (IDOT). Preliminary research on this bridge was performed by Clayton B. Fraser of Fraserdesign, Loveland, CO.

The period during which iron bowstring arch bridges proliferated in Iowa is an interesting episode in the history of bridges. Following the exceptional growth in Iowa's population in the wake of its admission to the Union in 1846, there was a need for a basic transportation infrastructure within the fledgling state. Now that Iowa's boundaries had been defined and the Native Americans had been displaced there was a plethora of land to be developed. State and local officials encouraged settlers to the new state. Settlers came from the eastern states and from Europe - Germany was the greatest supplier of these early immigrants, followed by Ireland, England, Scotland, and Scandinavia. They wrote home telling of the rich soil and readily available land, encouraging others to follow. During the 1850s Iowa's population more than tripled.[1]

The development of the state's agricultural industry was highly successful. By 1860 Iowa was the tenth largest producer of grain in the nation.[2] Major markets for Iowa's agricultural products were Chicago and the large eastern cities as well as the overseas markets of England, Scotland, and Ireland. This development could only be sustained if a sufficient transportation infrastructure were present. Where the transportation systems were most developed, hogs were raised. Where populations were less dense and transportation systems undeveloped, cattle were raised.[3]

The need to reach large out-of-state markets was met by the development of the railroad system in the state. This coincided with out-of-state interests to have the key hub of Chicago linked with the Mississippi and Missouri rivers which define Iowa's

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[1]Leland L. Sage, *History of Iowa,* Ames, IA: Iowa State University Press, 1974, p. 92. In 1850 the population was 192,214. By 1860 the population had risen dramatically to 674,913.

[2]William H. Thompson, *Transportation in Iowa: A Historical Summary*. Ames, IA: Iowa Department of Transportation, 1989, p.43. The major grains produced were(in order of decreasing significance): corn, wheat, oats, buckwheat, barley, and rye.

[3]Thompson, p.43.

eastern and western boundaries. In 1856 the United States Congress granted land to establish four railroads across the state. By 1866 rails had made it to Des Moines; one year later Council Bluffs on the Missouri River was reached.[4]

Although the railway system was vital to the economic development of the state, the intense concentration on the rail system did little to help development of the road systems. Roads were crude affairs. There was very little grading, and improvements were limited to filling in low spots to keep the roads above the water level during the rainy season.[5] Although little effort was put into developing road surfaces, the need to ford streams, rivers, and gullies was given great attention, leading to the need for a great number of bridges.

The responsibility for roads and bridges was for the most part strictly local. Initially townships, later the counties, took on the burden of developing and maintaining the roads. Typically, the cost of building a bridge would be funded by the county paying a large fraction (often 2/3) and the balance was paid by subscribers - that is, the adjacent landowners, merchants, and farmers who held a major stake in the bridge being built. The two principal rivers in Jones County - the Maquoketa and Wapsipinicon rivers were the major obstacles that required bridging. Spanning these two rivers, and their tributary creeks and streams, necessitated a sizable drain on the county coffers.[6]

The early bridges were made of wood and had very limited life expectancy. By the time that Iowa was admitted to the Union iron bridge technology was reaching a critical mass. The birth of iron bridges occurred in Britain following the development of industrial processes for the smelting of iron. The first iron bridge was built by Abraham Darby III in 1779 in Coalbrookdale, England. This was a cast-iron arch design which exploited the compressive strength of cast iron. Cast iron presented the early bridge designers with a problem, however, because it offered very poor strength when loaded in tension. In 1783 Henry Cort patented

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[4]Sage, p.112.

[5]Thompson, p.69.

[6]*History of Jones County, Iowa*. Chicago: Western Historical Company, 1879, p. 349-50 discusses the major bridge expenditures through 1878.

a method for shaping wrought-iron sections using rollers.[7] The following year he patented the puddling process for the conversion of cast iron to wrought iron. For the first time, wrought iron, capable of accepting compression *and* tension, was available in sufficient quantities in convenient shapes.

The first iron bridge in the United States was built in 1836 by Captain Richard Delafield of the Army Corps of Engineers in Brownsville, Pennsylvania. A decade latter, at the time of the creation of the state of Iowa, the railroads were beginning to build iron trusses. In 1841 Squire Whipple, of upstate New York, received a patent for a bowstring arch-truss.[8] This design consisted of a cast-iron arch with a wrought-iron lower chord, as well as diagonals and vertical rods of wrought iron. Many of these bridges were built in New York state, particularly for crossing the Erie Canal. Whipple's bowstring inspired many copies. In 1857 Thomas Moseley patented a bowstring design which used arches that were "built up of wrought plate iron...to give the whole arch transversely the form and strength of an arch, and to admit of very long spans without excessive weight, presenting at once the combined features of extraordinary strength and lightness."[9] The idea of building-up the upper chord was the key. Other patents would follow - all using built-up sections of one type or another.

The bowstring arch was the preferred design because of its efficient use of material. These bridges were slender, and relatively easy to erect. Moseley created the Moseley Bridge Company in Cincinnati and in 1861 one of his agents, Zenas King (along with a metalworker Peter Frees) took out his own patent for a bowstring bridge.[10] The company King created - the King Iron Bridge and Manufacturing Company of Cleveland, became a powerhouse in the iron bridge building industry. During the 1860s and 1870s they built hundreds of bowstring bridges throughout the nation. Other large bridge companies got in the act, including David Hammond's Wrought Iron Bridge Company of Canton, Ohio; and Joseph Davenport's Massillon Bridge Company of

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[7]Emory L. Kemp, "The Introduction of Cast and Wrought Iron in Bridge Building," *IA: The Journal of the Society for Industrial Archaeology* 19,no.2(1993): 5-16 presents an excellent discussion of the early use of iron in bridge building.

[8]Letters Patent No. 2064, April 24, 1841.

[9]Letters Patent No. 16,572, February 3, 1857.

[10]Letters Patent No. 33,384, October 1, 1861.

Massillon, Ohio. During this brief period thousands of bowstring arch bridges were built, spanning rivers, streams and gullies throughout the nation.

As intense as the bowstring building activity was, the bloom was short lived. Although the bowstring form is efficient in its use of material, it did suffer from some major problems. Because the upper chord members were bent to take the shape of the arch, each span length required a unique curve. This was a distinct manufacturability problem. The competing Pratt design, patented in 1844 by Thomas and Caleb Pratt, had straight upper and lower chords. Bridges of various spans could be accommodated by adding additional panels or simply selecting the appropriate element lengths, while the bowstring, with its fixed curved arch, could not. Probably, an even greater problem was the perception that the bridges were unsafe. The feelings of one Iowa state highway engineer from 1914 is indicative: "The bridges are light and flimsy. Everything about them is conducive to extreme and excessive vibration. Every man who has crossed one has noticed the trembling of the structure and the rattle of the rods and members of the bridge."[11]

The Fremont Mill Bridge is an excellent example of Davenport's bowstring design. Joseph Davenport was born the son of a Massachusetts clockmaker in 1815.[12] At 13 he left school. Two years later he became an apprentice to his brother Charles who manufactured coaches in Cambridge, Massachusetts. In 1832 Joseph and his brother produced the first American style of railway coaches, which had the aisle down the middle. In 1840, Davenport built the first cow-catcher.[13]

In the early 1850s, Davenport moved to Massillon, Ohio where he formed a partnership with Charles M. Russell to build steam cars, which were combination engine and coach. Davenport needed an inexpensive way to stiffen his cars. In 1859 he patented a

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[11]"Treacherous Danger in Bow String Bridge," *Iowa Highway Commission Service Bulletin*. August, 1914, p.7.

[12]Edward T. Heald, "Bridge Builders of Canton and Massillon." (Script 76, broadcast November 7, 1948, WHBC-WHBCFM) In *The Stark County Story*. Vol. 1. Canton:The Stark County Historical Society, 1949, presents a biography of Davenport and a history of the Massillon Iron Bridge Company.

[13]The plow-like contrivance attached to the front of a locomotive to push cows and other obstructions from the tracks.

railroad car whose floor was stiffened by the use of "open diagonally braced girders".[14] The same year he built an iron Howe truss bridge which employed the same lattice girder design.[15] After Russell's death, Davenport gave up the car business and devoted his efforts to building bridges. In 1867 he patented a bowstring arch design which employed his unique lattice girder.[16] Two years later, he founded (along with others) the Massillon Iron Bridge Company. Davenport's involvement with the company lasted only until 1875. He lived to be 97. The last years of his life he spent fishing and tinkering - building a model airship at age 94.

In the winter of 1872-73 an ice flow took out the bridge that carried the Old Military Road across the Maquoketa River at Monticello. This road was created by the United States government as part of a system of military roads to facilitate access to the nation's western frontier. In March of 1839 Congress appropriated twenty thousand dollars for surveying, grading, clearing of brush, and the construction of bridges - creating the road which was to connect Dubuque to Iowa City. The road was to further extend to the Missouri border and on to St. Louis. It provided access to the territorial capital, Iowa City, and was used to carry homesteaders in their covered wagons and federal troops traveling between established posts to quell Indian disturbances in the wilderness. The road also became important for local farmers who needed access to deliver their goods to market.

Many settlements sprang up along the Old Military Road. Among the most important was Monticello, situated where the Road crossed the south fork of the Maquoketa River. Monticello grew to become the second largest town in Jones County - surpassed in size only by Anamosa (which is also located on the road, eleven miles to the south.)[17] When the bridge at Monticello was

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[14]Letters Patent No. 23,333, March 22, 1859.

[15]David A. Simmons, "Two Ohio Structures Represent Earliest Period of Iron Bridges." *Ohio County Engineers News*, May, 1984:12-13. Oak Knoll Park Bridge, Massillon, Ohio. The bridge still survives. It can be found in the city park where it was moved to in 1899. It is "the oldest extant iron bridge in Ohio".

[16]Letters Patent No. 72,611, December 24, 1867.

[17]R.M. Corbit, *History of Jones County, Iowa: Past and Present*, Chicago: S.J. Clarke Publishing Co., 1910. Vol.1, p. 67 gives the population of the two towns as follows: 1870: Anamosa

destroyed it was seen as imperative that it be replaced. In April of 1873 the three man board of Supervisors for Jones County entertained sealed bids for a replacement bridge from five companies. The contract was awarded to the Massillon Iron Bridge Company who was represented by their agent Oliver S. Jacobs. One of the supervisors, S.M. Yoran was appointed the superintendent of the project.

A contractor from nearby Scotch Grove, James Milne, was awarded a contract for the bridge's foundations. The rates for the substructure were as follows:

Excavation: $0.25 per cubic yard
Piles: $0.50 per linear foot
Masonry work: $4.40 per cubic yard.

The grading of the approaches cost $251.80 (1,259 yards at $0.20/yard). The specified completion date for the bridge was 20 June 1873. The Board of Supervisors minutes indicate that the bridge was completed sometime prior to October of that year. The total project cost was $5,428.05, of which $2,944.00 went to Massillon for the superstructure.[18]

Given that the bridge was built during the peak of the bowstring-building era, it is not surprising that the bowstring form was employed here. The bridge had a 127' span and a width of 16'. The upper chord was built-up of flat iron plates forming the top and bottom flanges connected via a web of threaded crossed rods and gas-pipe sections configured in a Howe-truss pattern (diagonals in compression, verticals in tension). The angled intersections of the diagonal web pipe members and the parallel upper and lower chord strap-iron plates were accommodated by cast-iron fittings. This peculiar lattice arrangement is characteristic of bowstrings built by Massillon and was patented by Joseph Davenport in 1867.[19] The lower chord is composed of a pair of flat plates connected by bolts that also serve to attach the star-section vertical members to the lower chord.

Lateral stability was provided by a trio of lateral struts above the crown of the arch. These are slightly arched members with Howe trussing similar to the upper chord. Additional lateral

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2,083; Monticello 1,337; 1875: Anamosa 1,605; Monticello 1,587.

[18]Jones County Supervisors' Records, Book B: page 477 (9 April 1873), page 480 (10 April 1873), page 517 (22 October 1873), Jones County Courthouse, Anamosa, IA.

[19]Letters Patent No. 72,611, December 24, 1867.

stability was provided by a series of outrider brackets between the upper and lower chords. These outrider brackets were attached to deck beams that extended beyond the centerlines of the main trusses. The ends of the deckbeams served as attach points for star-iron outriders which were also connected to the upper chords. Both the upper lateral struts and the original deck beams were constructed of Davenport's patented lattice girders. At some later date, a new deck framing system of 9" I-section floor beams, 8" x 8" wooden floor beams, and 6" I-section stringers was added.

The Old Military Road eventually faded away. When U.S. highway 151 was designed, it followed much of the path of the old road, including for a time the section that included the Fremont Mill Bridge. When the highway was realigned in 1929 the bridge was moved to Fremont in Cass Township, Jones County, over Buffalo Creek, two miles north of Stone City, where it was used along with six I-beam and wood approach spans. It is probable that the bridge was used to replace a bridge built in 1868.[20]

It was service at this site that gave the bridge its current name. The old mill at Fremont was built in 1848 by Gideon H. Ford.[21] The small cluster of buildings that was known as Fremont developed around the mill. In 1876 the mill was purchased by Nicholas Dahlem, who previously was employed as a miller at the mill. The mill's capacity was "about one hundred and sixty bushels per day of twenty-four hours."[22]

In 1985 the bridge was replaced by a 174' by 30', five-span concrete slab bridge. The contract called for the contractor, Grimshaw Construction Company, of Winfield, Iowa to remove the bridge to a new location, where it rests today, in Jones County Conservation Park ("Central Park") in Center Junction, Jackson Township. Here it serves to carry pedestrians over a small finger of a lake in the park. One important function that the bridge fulfills today is to stand as an exemplar of the nation's engineering heritage.

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[20]*History of Jones County, Iowa*. Chicago: Western Historical Company, 1879, p. 349 mentions an appropriation for a $3,000 bridge "at Fremont's Mills...to bridge Buffalo Creek."

[21]Corbit, vol.1, p.256

[22]*History of Jones County, Iowa*, p. 694, the biography of Nicholas Dahlem.

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ADDENDUM TO
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This appendix is an addendum to a 10-page report previously transmitted to the Library of Congress.

APPENDIX: ADDITIONAL REFERENCES

Interested readers may consult the Historical Overview of Iowa Bridges, HAER No. IA-88: "This historical overview of bridges in Iowa was prepared as part of Iowa Historic Bridges Recording Project - I and II, conducted during the summers of 1995 and 1996 by the Historic American Engineering Record (HAER). The purpose of the overview was to provide a unified historical context for the bridges involved in the recording projects."

This bridge was also covered by the Structural Study of Iron Bowstring Bridges, HAER No. IA-90: "Three iron bowstring bridges, built by three Ohio bridge fabricating companies in the 1870s, were selected for engineering analysis and evaluation based on modern structural theory and structural theory as it was known at the time the bridges were constructed."